Next-Generation Grid Components R&D Program Planning Workshop, Pittsburgh, PA

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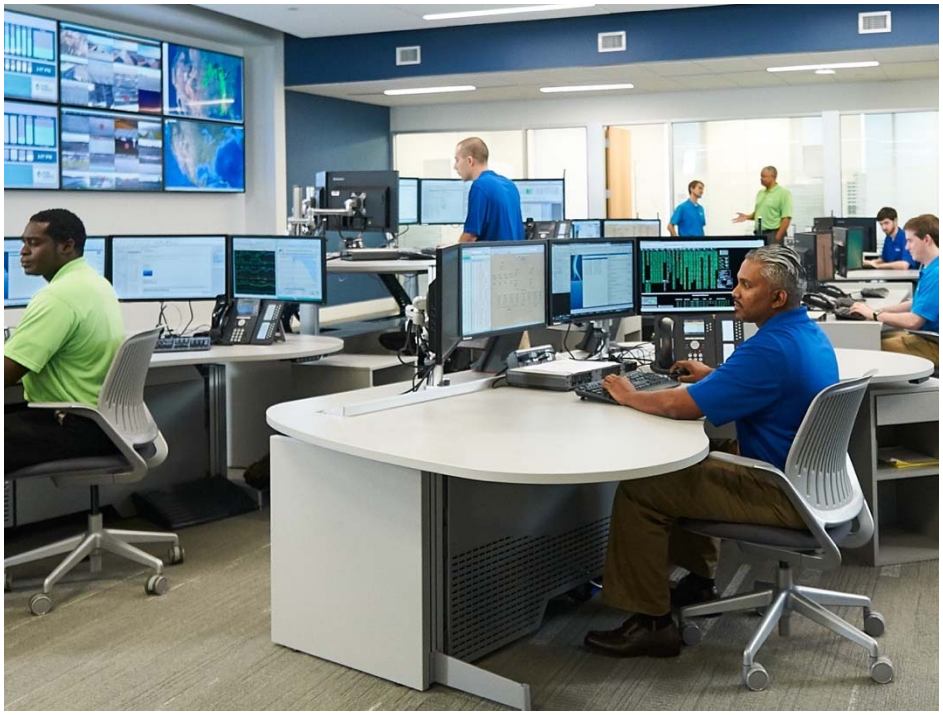

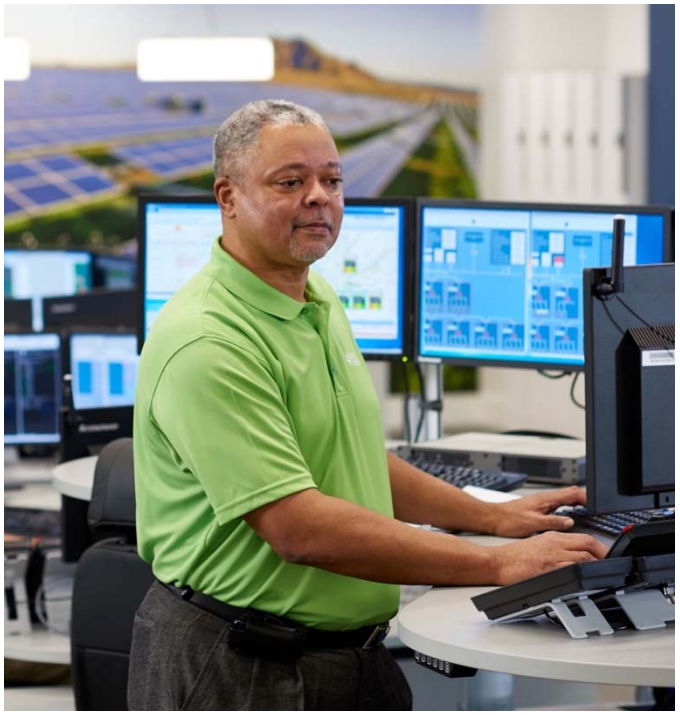

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Challenges coming down the line that will impact the design or requirements of future grid components

- Increased penetration of distributed energy resources (DER's) at T&D
  - Seeing larger installations, 20 MW, wanting to connect to distribution
  - More integration issues such as voltage swings, transformer in-rush, reverse power flows, system capacity, etc.
  - Driving the need for grid edge intelligence
  - Existing generation planning tools are running into convergence issues with large amounts of non-firm PV

- Increased dependency on gas generation
  - Lower system inertia associated with smaller units
  - Vulnerability to gas supply
  - Less centralized generation

Challenges coming down the line that will impact the design or requirements of future grid components

- Need for end-to-end resource planning tool to accurately model and operate the future grid
- Customers want choice and control regardless of market structure
- Flat to declining load growth in regulated service areas due to DER's and energy efficiency
- Shift to more distributed functions and advanced analytics

Challenges coming down the line that will impact the design or requirements of future grid components

- Heightened need for cyber security and privacy
- Heightened need for more physical security around facilities and visibility inside substations
- Internet of Things drives connectivity to all things (utility and customer-owned)

Wish list of component capabilities and requirements

- A reference architecture and framework for distributed intelligence like OpenFMB
- A common data model like the IEC Common Information Model (CIM)
- Ability to use Internet of Things (IoT) publish/subscribe protocols for peer to peer communication (like DDS, MQTT, and AMQP)
- Integrated GPS clock to provide time accuracy and synchronization of grid events
- Faster response from controllable load/gen to bridge some of the gaps associated with lower inertia, including dynamic response

Wish list of component capabilities and requirements

- Ability to run distributed applications on devices at the edge
- Low communication latencies to run distributed control sequences especially with regards to microgrids
- Granular and accurate sensor data – PMU type data on grid edge devices
- Devices with the ability to scale independently without a system wide rollout
- Large-scale economical energy storage
- More and faster visibility of real time conditions and equipment status throughout the system

Wish list of component capabilities and requirements

- Solid-state Synchronous Inverter – looks and acts like a synchronous generator
- Inertia emulation type devices
- Advanced controls down to 120 V levels for reactive power, demand response and PV integration
- Solar and storage need to have the same capabilities as conventional generation and need to work together to perform that way
- What to do when the cyber equipment fails or is compromised (ie Ukraine event).

What Duke Energy is doing to prepare for and accommodate these challenges or needs

- Participating in industry working groups and workshops related to these issues
- Studying possible future scenarios of our system – what ifs
- Promoting the need for open, interoperable standards like OpenFMB, now adopted by NAESB, throughout our utility and industry partners
- Built systems to pilot these technologies to try and figure out how to work with our vendors to commercialize this technology

What Duke Energy is doing to prepare for and accommodate these challenges or needs

- Working closely with the DOE, APRAe, and National Labs, and university to continue to push more intelligence throughout the grid (substations, grid nodes, and all the way to the premise)
- Published a Distributed Intelligence Platform document where the use of distributed technologies is discussed
- Evaluating not only the technical challenges with grid edge intelligence; but also evaluating the financial implications of this work


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